net horse-power, and at one-eleventh of the stroke only 47 horse-power, and in that proportion. Each experiment lasted seventy-two hours. The water was carefully measured as it was taken into the boiler; and the steam which resulted from that water was estimated from the indicator diagrams as it went into the condenser. The result of these trials is thus stated in a note, quoting the figures from the report: —

"In round numbers twelve hundred pounds of water an hour disappeared from the engine, whether the steam followed the piston full stroke, or was cut off at one-eleventh of the stroke; and, of course, the expansion rate had nothing to do with its loss. Indeed, at the high expansion there appeared less loss of water than at lower rates. The fact, of course, was that the double-balanced puppet-valves of that engine leaked about the same amount of steam into the condenser an hour when the engine was running, and it made no particular difference whether the cut-off was long or short.

"If the estimated water in steam, as shown by the indicator, could have been ascertained as accurately as the water pumped in was, it would have appeared that at the high rates a still smaller loss occurred than the tables show, as compared with full stroke; because, after the cut-off valve shuts, the steam-pressure falls off in the cylinder, and less steam ought to leak into the condenser than if the boiler-pressure were kept up in the cylinder during its entire stroke; but these indicator measurements cannot be exactly accurate. They, however, established the fact that in this case high expansion destroyed less steam than full stroke, and so completely demolished the theory which the experiment was tried to establish. That, however, did not prevent the forcing of balances, and other similar manipulation of the honest figures, in order to prove the hypothesis under which the experiment was tried; and the result was announced that the Lake Erie experiment had proved what it was intended to prove, and the official United States Government report was issued to the world, announcing the new discovery.

"If book-keeping could have beaten James Watt, he and his laws would have perished from the earth; but, as it was, they were only driven for a season out of the American Navy."

It is not important for science to know whether the conclusion drawn from the facts was fraudulent, as the lecturer asserts, or simply a stupid blunder. The fact is, that an almost constant quantity, of steam disappeared from the engine in an hour, under all circumstances, and of course its loss had nothing to do with expansion. The quantity — twelve hundred pounds an hour — was a very large percentage of 47 horse-power, and a small percentage of 280 horse-power; and this fact was put forward as proving that expansion destroyed a much larger amount of steam used than full stroke did, whereas in fact a trifle less steam was destroyed when high expansion was used than at any other time.

The explanation, open to any one's verification by the tables themselves, disposes of this extraordinary trial, and destroys the theory based upon it. It is great service to truth to make this exposure.

The lecture ends with this expression of opinion: —

"It is my opinion, that, with our present knowledge of machinery, a steam-engine can be built to day that will produce a horse-power with three-quarters of a pound of coal an hour, if of sufficient size to reduce the percentages of loss by radiation, friction, and leakage, to a minimum. Under those circumstances, your fuel expense would be less than one-third of what it now is."

It would seem that there should be some means of bringing this to a test. No one claims at present less than a pound and a half an hour in the most elaborate and extensive steamers; and, if this opinion is correct, half the coal now used, or a power double that now got from the same fuel in the most perfect machine, would be the result of such an engine.

In a review we cannot go over the whole ground on which the lecturer places the case; but to those specially interested in the subject there is matter enough for very serious consideration, and we commend the paper to their notice.

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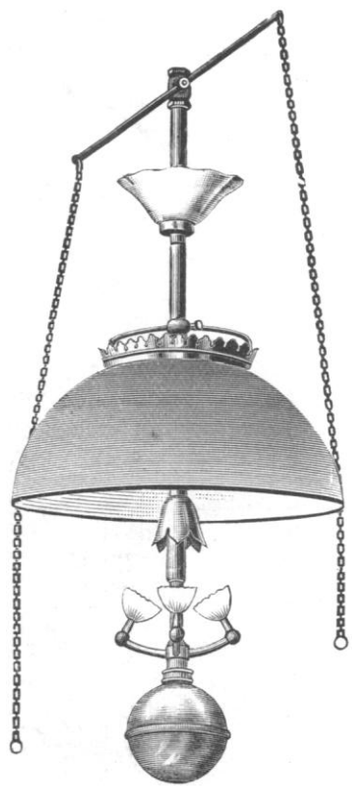
SETH K. WARREN of Geneva Lake, Wis., publishes a little volume devoted to the "Evolution Theory of the Origin of Worlds."

## IMPROVED GASLIGHT.

NOTWITHSTANDING the rapid development of the electric-light industry, gas still remains the most widely used and convenient illuminant; and any means of improving the quality or decreasing the cost of gaslight is of interest to the public. One improvement in both these features, now attracting much attention, is known as the "albo-carbon light."

In this light the ordinary illuminating-gas is passed through a simple apparatus, in which it is enriched by taking up a hydrocarbon vaporized by a current of heated gas. It is claimed by the company who have introduced it to the public that one thousand feet of common coal-gas, after being passed through their appliance, will give fully as much illumination as three thousand feet where ordinary burners are used: in other words, the cost of illumination is reduced to at least one-half, while the light is far more satisfactory. The apparatus can be attached to any ordinary gas-pipe or gas-fixture in a few minutes, and no change in the meter or



THE ALBO-CARBON GAS-FIXTURE.

gas service is required. The carburetting vessel is detachable, and may be readily removed from the fixture for refilling with "carbon." This operation is quickly performed, and the whole appliance is so simple that it requires practically no attention. There is no complicated mechanism, and consequently nothing to get out of order.

The adaptability of this light for illuminating purposes under all circumstances is proved by the fact that it is now in use in many of the largest business-houses in this city and Brooklyn. Professor Stevens of Girard College, Philadelphia, says of it, "I have tested the albo-carbon light. . . . The burner consumed 2 cubic feet of gas per hour. One foot of common gas per hour equalled 2.5 candles, while one foot of the gas when carbonized equalled 8.125 candles. Regarding candle-power, the carbonized gas is equal to 3.25 times the common gas. Comparing the common gas with the standard 5-foot Argand burner, 5 feet per hour with the Argand burner equalled 17.20 candles; 5 feet of carbonized gas equalled 40.625 candles, which is 2.36 times the candle-power of the standard Argand. . . . The perfectly steady, soft light furnished by the albo-carbon burner adapts the light admirably for reading, for manufacturing establishments especially, and for general household uses."

The tests referred to above refer only to single lights: when the

albo-carbon light is burned in clusters of burners, a much more striking effect, with a far higher result in lighting-power, is produced. An eight-light cluster tested on London 16-candle gas gave 8.84 candles per cubic foot, while with the larger clusters the increase in candle-power is still greater. This light may be seen in use every evening at 728 Broadway, this city, the office of the Albo-Carbon Light Company.

## THE NEW WESTON VOLTMETER.

IT is a law of human progress, nowhere better exemplified than in the industrial and mechanic arts, that all systematic and permanent advance depends upon our ability to determine quantitatively, in terms of some standard, the value of the various factors involved in any given operation or transformation. An idea of the crudeness of men's notions of measurement in former times as compared with the present, may be gained from the names of units or standards which have been handed down to us. Thus three barley-corns made one inch, the foot was the length of the king's pedal extremity, the hand is a measure still in use in estimating the height of horses, etc. Compare such notions with the accuracy required in modern machine-shop practice. It is, in fact, only when the value of work already done becomes known, that one is prepared to make further progress, as every step in advance demands increased refinement in the means and methods of measurement. As an instance in point, witness the mutual development of the steam-engine and the steam-engine indicator. Just as the indicator has advanced to a state of perfection such that its records are universally relied upon to detect faults in present apparatus, and intelligently outline the direction of improvement, so has there been a gradual advance in the construction of commercial electrical measuring instruments, serving a similar purpose, and tending to effect a similar result, in electrical engineering.

While it is true that thousands of engines are never indicated, and thousands of electrical appliances are never carefully tested, it is equally true, as a consequence, that useful energy is wasted, property destroyed, and money lost.

In electrical as well as in mechanical engineering, success necessitates the elimination of guesswork and the substitution of knowledge. Engines, dynamos, batteries, electric motors and lamps, are sold with a guaranteed efficiency and life, subject, however, to definite conditions as to use. It is generally because of the absence of definite knowledge as to when the imposed conditions are actually observed, that losses so frequently exceed profits. When measurements of the value of electrical appliances are actually made, the results are often discredited because of doubt as to the accuracy of the instruments used, and probably the general indifference to accurate work manifested by many electricians may be justly ascribed to the absence of reliable measuring instruments.

Most of the commercial electrical measuring instruments in use in this country to-day are of foreign manufacture. They may be briefly described as either of the permanent or electro magnet type. The former are in general disfavor, and unjustly so, because their defects are not inherent in the types, but are, rather, the natural result of poor design and construction. Those who have had much


FIG. 1.

experience with these instruments, of which the Deprez and Ayrton & Perry are examples, will recognize the fact that while these instruments are new, they are subject to rapid and serious changes in their constant. The rate of change, however, diminishes with age and use, up to a certain period, when they assume a condition of stability, and are thenceforth, in so far as the controlling force is concerned, reasonably reliable. Uncertainty as to when this condition of stability is attained necessitates frequent calibration, and is thus a serious obstacle to accurate work. A second defect is the heating error introduced when the instruments were kept in circuit even for the short time necessary to make readings.

Instruments of the electro-magnet type are, on the other hand, more generally in demand, because of the prevalent idea that they are not subject to errors arising from a variable controlling force. Errors, however, fully as serious as have been ascribed to permanent magnets, are not only common, but seemingly inherent, in this type, because of the magnetic persistency of the softest iron, even when subdivided. This error is most noticeable when readings are made with a rising, succeeded by a falling current, and often amounts to as much as twenty-five or thirty per cent. The best forms of this type of instrument are, perhaps, the ingenious